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Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

（博士課程）
Doctoral Program

論 文 要 約

THESIS OUTLINE

専攻： Department of	Chemical Science and Engineering	専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（Engineering）
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要約
Thesis Outline

Thesis Title: **Process Intensification of Methane Pyrolysis using Molten Metal Bubble Column for Hydrogen Production**

This research work aims to investigate different possibilities of process intensification for hydrogen production by methane pyrolysis in molten metal reactors. The thesis was structured and divided into 5 chapters as follows:

Chapter 1: Introduction; describes the background, principles of hydrogen as a clean energy carrier and its various production methods and particularly by methane pyrolysis in molten metal as a heat transfer medium in a bubble column reactor, as well as the objectives and structure of the study.

Chapter 2: Experiments of Molten Metal-Based Methane Pyrolysis; describes the experimental study of methane pyrolysis in Molten Metal Bubble Column (MMBC) for hydrogen production. Parameters such as molten metal temperature and molten metal type are changed for a study of their effects on methane conversion. The produced carbon is also analyzed for purity and morphology. A horizontal reactor is also used to investigate the effect of the presence of a molten metal surface in a conventional tubular reactor.

Chapter 3: Catalytic Surface Reaction Kinetic Analysis; a parallel reaction scheme is suggested for the process in which part of the reaction occurs inside the bubble as a gas phase reaction and the other part is a catalytic surface reaction on the bubble-metal interface. The surface reaction kinetics are estimated, and the model is used for the estimation of conversions at different operating conditions for further reactor design stages. The surface kinetics derived from the study are also employed to validate the proposed mechanism by comparing the experimental conversion of the horizontal reactor to the calculated conversions obtained using the parallel reaction model.

Chapter 4: Plasma-assisted Molten Metal-Based Methane Pyrolysis; the process is intensified by the addition of plasma discharge to the system by modifying both the horizontal reactor and the MMBC reactor. Since no prior research has proposed this specific combination, the aim of this chapter is to comprehend the phenomena involved and ultimately establish a proof of concept. The plasma effect on conversion is discussed, as well as the limitation of the process, which requires further research.

Chapter 5: Conclusion; summarizes the findings of this study and provides prospects.